

Listing of Claims:

This listing of claims reflects all claim amendments and replaces all prior versions and listings of claims in the application. Material to be inserted is in **underline**, and material to be deleted is in ~~strikeout~~ or (if the deletion is of five or fewer consecutive characters or would be difficult to see) in double brackets [[]].

1-35. (Cancelled)

36. (Currently amended) **A method of making an integrated circuit, the integrated circuit including a composite dielectric layer having a first silane-containing layer, a second silane-containing layer, and a low dielectric constant polymer layer disposed between the first and second silane-containing layers, the method comprising:**
depositing the first silane-containing layer on the substrate;
depositing the low dielectric constant polymer layer on the first silane-containing layer; and
depositing the second silane-containing layer on the low dielectric constant polymer layer,

wherein the low dielectric constant polymer layer is deposited by exposing the first silane-containing layer to a concentration of a gas phase diradical **monomer**, and condensing and polymerizing the gas phase monomer on the first silane-containing layer.

37. (Original) The method of claim 36, wherein the substrate is maintained below a crystallization temperature of the low dielectric constant polymer layer while the low dielectric

constant polymer layer is being deposited.

38. (Original) The method of claim 36, wherein the low dielectric constant polymer layer is at least partially formed from a poly(paraxylylene) having a general formula of $-(C(F_xH_{2-x})-(C_6F_yH_{4-y})-C(F_xH_{2-x})-)$, wherein $x = 0, 1$ or 2 , and wherein $y = 0, 1, 2, 3$ or 4 .

39. (Original) The method of claim 38, wherein the gas phase monomer is a diradical a diradical monomer having a general formula of $Ar-(CZ'Z''^*)_2$, wherein Ar is an aromatic group or a fluorine-substituted aromatic group.

40. (Original) The method of claim 39, wherein the substrate is maintained at a temperature below the crystallization temperature of the diradical while the low dielectric constant polymer layer is deposited.

41. (Original) The method of claim 40, wherein the substrate is maintained at a temperature of between -30 and -50 degrees Celsius while the low dielectric constant polymer layer is deposited.

42. (Currently amended) **A method of making an integrated circuit, the integrated circuit including a composite dielectric layer having a first silane-containing layer, a second silane-containing layer, and a low dielectric constant polymer layer disposed between the first and second silane-containing layers, the method comprising:**

depositing the first silane-containing layer on the substrate;

depositing the low dielectric constant polymer layer on the first silane-containing layer; and

depositing the second silane-containing layer on the low dielectric constant polymer layer,

wherein the first silane-containing layer is formed at least partially from an organosilane material selected from materials having a general formula of $(RZ)_x-Si-(W-T)_y$, wherein W is selected from the group consisting of $-O-$, $-CH_2-$, $-(CH_2)_aC=OO-$, and $-(CH_2)_a-OO=C-$; wherein T is selected from the group consisting of $-CR=CR'R''$, an alkyl halide, and $-RC=O$; wherein Z is selected from the group consisting of O and NR, wherein R, R' and R'' are an H, alkyl or aromatic group; wherein a is 0 or an integer; wherein $x = 1, 2$ or 3 ; wherein $y = 1, 2$ or 3 ; and wherein $x + y = 4$.

43. (Original) The method of claim 42, wherein the substrate contains silicon, and wherein the first silane-containing layer is chemically bonded to the substrate via a plurality of Si-Z-Si bonds ($Z = O$ or NR, where R is an alkyl or aromatic compound) formed between silane groups in the first silane-containing layer and the silicon in the substrate.

44. (Currently amended) A method of making an integrated circuit, the integrated circuit including a composite dielectric layer having a first silane-containing layer, a second silane-containing layer, and a low dielectric constant polymer layer disposed between the first and second silane-containing layers, the method comprising:

depositing the first silane-containing layer on the substrate;

depositing the low dielectric constant polymer layer on the first silane-containing

layer; and

depositing the second silane-containing layer on the low dielectric constant polymer

layer,

further comprising exposing the first silane-containing layer to at least one of UV radiation and heat before depositing the low dielectric constant polymer layer to create free radicals from vinyl groups in the first silane-containing layer.

45. (Currently amended) A method of making an integrated circuit, the integrated circuit including a composite dielectric layer having a first silane-containing layer, a second silane-containing layer, and a low dielectric constant polymer layer disposed between the first and second silane-containing layers, the method comprising:

depositing the first silane-containing layer on the substrate;

depositing the low dielectric constant polymer layer on the first silane-containing

layer; and

depositing the second silane-containing layer on the low dielectric constant polymer

layer,

further comprising exposing the second silane-containing layer to at least one of UV radiation and heat after depositing the second silane-containing layer to chemically bond the second ~~adhesion-promotion~~ silane-containing layer to the low dielectric constant polymer layer.

46. (Currently amended) A method of making an integrated circuit, the integrated circuit including a composite dielectric layer having a first silane-containing layer, a second silane-containing layer, and a low dielectric constant polymer layer disposed between the first and

second silane-containing layers, the method comprising:

depositing the first silane-containing layer on the substrate;

depositing the low dielectric constant polymer layer on the first silane-containing layer; and

depositing the second silane-containing layer on the low dielectric constant polymer layer,

further comprising heating the composite dielectric layer in the presence of hydrogen after depositing the second silane-containing layer.

47. (Original) The method of claim 46, wherein heating the composite dielectric layer under hydrogen includes heating the composite dielectric layer under a mixture of 3-10% hydrogen in an inert gas.

48. (Original) The method of claim 46, further comprising exposing the second silane-containing layer to thermal energy to chemically react the second silane-containing layer with the low dielectric constant polymer layer before heating the composite dielectric layer in hydrogen.

49. (Original) The method of claim 46, further comprising exposing the second silane-containing layer to UV radiation before heating the composite dielectric layer in the presence of hydrogen to react the second silane-containing layer with the low dielectric constant polymer layer.

50. (Original) The method of claim 46, wherein the composite dielectric layer is heated under hydrogen for 0.5-10 minutes

51. (Original) The method of claim 50, wherein the composite dielectric layer is heated under hydrogen for 3-4 minutes.

52. (Original) The method of claim 46, wherein the composite dielectric layer is heated under hydrogen to a temperature of 300-400 degrees Celsius.

53. (Currently amended) **A method of making an integrated circuit, the integrated circuit including a composite dielectric layer having a first silane-containing layer, a second silane-containing layer, and a low dielectric constant polymer layer disposed between the first and second silane-containing layers, the method comprising:**

depositing the first silane-containing layer on the substrate;

depositing the low dielectric constant polymer layer on the first silane-containing layer; and

depositing the second silane-containing layer on the low dielectric constant polymer layer,

wherein the substrate includes a surface, further comprising exposing the substrate to UV radiation before depositing the first silane-containing layer to remove water from the substrate surface.

54. (Currently amended) A method of making an integrated circuit, the integrated circuit

including an adhesion promoter layer disposed on a substrate and a low dielectric constant polymer layer disposed on the adhesion promoter layer, the method comprising:

depositing a silane material onto the substrate;

exposing the ~~adhesion promoter layer~~ silane material to a free radical generating energy source to generate free radicals from vinyl functional groups on the silane material, wherein some free radicals react to form the adhesion promoter layer, and wherein other free radicals are available to react with the low dielectric constant polymer layer;

depositing the low dielectric constant polymer layer on the adhesion promoter layer by exposing the substrate to a concentration of a gas phase free radical, wherein at least some of said other free radicals react with the low dielectric constant layer as it is deposited; and

heating the adhesion promoter layer and the polymer dielectric in the presence of a reducing gas hydrogen.

55. (Original) The method of claim 54, wherein the low dielectric constant polymer layer is deposited while the substrate is held at a temperature of between approximately -30 and -50 degrees Celsius.

56. (Currently amended) The method of claim 54 55, wherein the reducing gas includes hydrogen ~~low dielectric constant polymer layer is deposited while the substrate is held at a temperature of between approximately -30 and -50 degrees Celsius.~~

57. (Currently amended) The method of claim 54, wherein the adhesion promoter layer is a first adhesion promoter layer, further comprising depositing a second adhesion promoter layer on

low dielectric constant polymer layer before heating under the reducing gas hydrogen.

58. (Original) The method of claim 57, further comprising exposing the second adhesion promoter layer to free radical generating energy after depositing the second adhesion promoter layer.

59. (Original) The method of claim 58, wherein the free radical generating energy is UV light.

60. (Original) The method of claim 54, wherein the silane material is selected from materials having a general formula of $(RZ)_x-Si-(W-T)_y$, wherein W is selected from the group consisting of $-O-$, $-CH_2-$, $-(CH_2)_aC=OO-$, and $-(CH_2)_a-OO=C-$; wherein T is selected from the group consisting of $-CR=CR'R''$, an alkyl halide, and $-RC=O$; wherein Z is selected from the group consisting of O and NR, wherein R, R' and R'' are an H, alkyl or aromatic group; wherein a is 0 or an integer; wherein $x = 1, 2$ or 3; wherein $y = 1, 2$ or 3; and wherein $x + y = 4$.

61. (Original) The method of claim 54, wherein the low dielectric constant polymer layer is formed from a polymer material having a dielectric constant of less than 2.6.

62. (Original) The method of claim 61, wherein the low dielectric constant polymer layer is formed from a poly(paraxylylene) having a general formula of $-(C(F_xH_{2-x})-(C_6F_yH_{4-y})-C(F_xH_{2-x})-)$, wherein $x = 0, 1$ or 2, and wherein $y = 0, 1, 2, 3$ or 4.

63. (Original) The method of claim 62, wherein the low dielectric constant polymer layer is formed from a poly(paraxylylene)-based material having a general structure of $-(CF_2-(C_6H_4)-CF_2)-$, and wherein the low dielectric constant polymer layer is deposited with an initial crystallinity of at least 20% in a β_2 phase of the material.

64. (Original) The method of claim 54, wherein the low dielectric constant polymer layer is formed from a monomer having a general formula of $X'_m-Ar-(CZ'Z''Y')_n$, wherein Ar is an aromatic group or a fluorine-substituted aromatic group, wherein Z' and Z'' are selected from the group consisting of H, F and C_6H_5 , wherein X' and Y' are leaving groups removable to generate free radicals, wherein m and n are each equal to zero or an integer, and wherein $m + n$ is less than or equal to a total number of sp^2 hybridized carbons on Ar available for substitution.

65. (Original) The method of claim 54, further comprising exposing the substrate to ultraviolet radiation before depositing the silane material onto the substrate to remove water from a surface of the substrate.

66. (Currently amended) The method of claim 54, wherein heating the adhesion promoter layer and the low dielectric constant polymer layer in the presence of hydrogen the reducing gas includes heating the adhesion promoter layer and the low dielectric constant polymer layer under a mixture of 3-10% hydrogen in an inert gas.

67. (Currently amended) The method of claim 54, wherein the adhesion promoter layer and the low dielectric constant polymer layer are heated under the reducing gas hydrogen for 0.5-10

minutes.

68. (Currently amended) The method of claim 54, wherein the adhesion promoter layer and the low dielectric constant polymer layer are heated under the reducing gas hydrogen for 3-4 minutes.

69. (Currently amended) The method of claim 54, wherein the adhesion promoter layer and the low dielectric constant polymer layer are heated under the reducing gas hydrogen to a temperature of 300-400 degrees Celsius.

70. (Currently amended) The method of claim 54, wherein the adhesion promoter layer and the low dielectric constant polymer layer are heated under the reducing gas hydrogen to a temperature of 350-400 degrees Celsius.

71. (Original) A method of making an integrated circuit, the integrated circuit including a polymer dielectric layer disposed on an underlying silicon-containing layer, comprising:

exposing the silicon-containing layer to UV radiation;

depositing the polymer dielectric layer on the silicon-containing layer after exposing the silicon-containing layer to UV radiation by exposing the substrate to a concentration of a gas-phase free radical; and

heating the polymer dielectric layer in a presence of hydrogen, wherein heating the polymer dielectric layer in the presence of hydrogen caps unreacted free radicals with hydrogen.

72. (Original) The method of claim 71, wherein the gas-phase free radical is a diradical having a diradical monomer having a general formula of $\text{Ar}-(\text{CZ}'\text{Z}''^*)_2$, wherein Ar is an aromatic group or a fluorine-substituted aromatic group.

73. (Original) The method of claim 71, wherein the polymer dielectric layer has a dielectric constant of less than 2.6.

74. (Original) The method of claim 71, further comprising depositing an adhesion promoter layer over the polymer dielectric layer, wherein the adhesion promoter layer is formed at least partially from a silane material selected from materials having a general formula of $(\text{RZ})_x\text{-Si}-(\text{W-T})_y$, wherein W is selected from the group consisting of $-\text{O}-$, $-\text{CH}_2-$, $-(\text{CH}_2)_a\text{C=OO}-$, and $-(\text{CH}_2)_a\text{OO=C}-$; wherein T is selected from the group consisting of $-\text{CR}=\text{CR}'\text{R}''$, an alkyl halide, and $-\text{RC=O}$; wherein Z is selected from the group consisting of O and NR, wherein R, R' and R'' are an H, alkyl or aromatic group; wherein a is 0 or an integer; wherein $x = 1, 2$ or 3 ; wherein $y = 1, 2$ or 3 ; and wherein $x + y = 4$.

75. (Original) The method of claim 74, further comprising exposing the adhesion promoter layer to a free radical generating energy source to generate free radicals from vinyl groups in the adhesion promoter layer to chemically bond with unreacted free radicals in the adhesion promoter layer before heating in the presence of hydrogen.

76. (Original) The method of claim 75, wherein the free radical generating energy source is a UV light source.

77. (Original) The method of claim 75, wherein the free radical generating energy source is a thermal energy source.

78. (Original) The method of claim 71, further comprising depositing an adhesion promoter layer on the silicon-containing layer before depositing the polymer dielectric layer.